



Horizon Project

NMC Horizon Project Short List

2013 K-12 Edition

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Time-to-Adoption: One Year or Less

BYOD

The term BYOD, which stands for “Bring Your Own Device,” refers to the practice of students bringing their own laptops, tablets, smartphones, or other mobile devices with them to class. Intel coined the term in 2009, when the company observed that an increasing number of its employees were using their own devices and connecting them to the corporate network. Since then, this type of activity has become commonplace in workplaces all over the globe. The BYOD movement in education institutions is being driven by a major challenge that many institutions face — a lack of funds to support one-to-one learning, which is a systemic solution in which every student is provided a laptop or mobile device that can be used to support learning in and outside of the classroom. BYOD makes one-to-one easier by simply leveraging the devices that students already have, or those their parents could buy for them. In practice, it has proven important to provide funds to support families in financial need, and to standardize on a small set of devices and software packages. Often the school will negotiate advantageous pricing for families to reduce their costs. In early studies, the act of a student using his or her own device for learning has proven to increase productivity and engagement. Tablet computing has accelerated the pace of BYOD, especially in schools, where these smaller, less-expensive devices are seen as a better option than traditional laptops. With their ever-growing capabilities, tablets (which now include an expanding set of choices, such as the iPad, Galaxy, Nexus, and Surface), are well positioned for BYOD environments.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Because BYOD allows students access to the same devices at school and at home, it can extend learning opportunities to times and places outside of the classroom.
- BYOD policies allow students to work with technology with which they are already comfortable and familiar.
- BYOD programs eliminate the support and other burdens from schools that go along with paying for and maintaining institution-provided devices.

BYOD in Practice

- Cheshire Public Schools in Connecticut have launched a BYOD pilot program that involves students bringing their preferred devices to school, and using Google Drive for assignments and improved collaboration: go.nmc.org/cps.
- Katy Independent School District in Texas partnered with Cisco on a BYOD strategy. Teachers and students have reported increased engagement: go.nmc.org/katyisd.
- Robert Gray Middle School in Oregon recently deployed a BYOD initiative to help students, teachers, and parents better understand educational uses of handheld technology. Their hope is that the Robert Gray BYOD model can scale to other schools: go.nmc.org/rgms.

For Further Reading

Are Schools Prepared to Let Students BYOD?

go.nmc.org/isyour

(Peter DeWitt, *Education Week*, 26 August 2012.) This article outlines a set of questions and criteria for schools to determine if they are BYOD-ready.

What Districts Should Know About BYOD and Digital Learning

go.nmc.org/whadis

(Jonathan P. Costa, *EdTech Magazine*, 2 January 2013). A veteran educator and consultant shares five lessons that can help school districts ease their transition into BYOD.

Time-to-Adoption: One Year or Less

Cloud Computing

Cloud computing refers to expandable, on-demand services and tools that are served to the user via the Internet from a specialized data center and do not live on a user's device. Cloud computing resources support collaboration, file storage, virtualization, and access to computing cycles, and the number of available applications that rely on cloud technologies have grown to the point that few institutions do not make some use of the cloud, whether as a matter of policy or not. Cloud computing is often used as a synonym for grid computing, in which unused processing cycles of all computers in a single network are leveraged to troubleshoot issues that cannot be resolved by a single machine. The primary distinction is how the host computers are accessed. Clouds, especially those supported by dedicated data centers, can be public, private, secure, or a hybrid of any or all of these. Many businesses, organizations, and institutions use storage, software (SAAS), and API services to reduce IT overhead costs. Google Apps, a SAAS provider, for example, has become a popular choice for education institutions and many have moved their email infrastructure to Gmail and adopted Google Docs for document sharing and collaboration, but such services do not meet the high security needs of many corporations or government agencies. Private cloud computing solves these issues by providing common cloud solutions in secure environments. Hybrid clouds provide the benefits of both types. Whether connecting at home, work, school, on the road, or in social spaces, nearly everyone who uses the network relies on cloud computing to access or share their information and applications.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- The adoption of cloud-based platforms and services provides a more flexible means of adjusting a school's infrastructure and technology portfolio to the needs of the moment.
- Cloud resources are often free and very simple to use, making access to storage, tools, media, and educational materials much more accessible than ever before.
- Online access to documents and applications facilitates greater flexibility, enabling students and teachers to create and edit their own materials and to consult and review information wherever and whenever they need it.

Cloud Computing in Practice

- As part of the national preparedness for potential pandemics, all of the Learning Management Systems in Singapore used by Ministry of Education schools now operate in the cloud: go.nmc.org/zduav.
- Powered by cloud computing, schools in Brazil are collaborating on a blog for the Global Curriculum Project, where students participate in a virtual exchange program with schools across five different countries: go.nmc.org/curric.

For Further Reading

Industry Perspective: Accelerate Education With Open Source Cloud Techs

go.nmc.org/accel

(David Egts, *Government Technology*, 26 February 2013.) This article cites cloud computing as instrumental to the evolution of online learning, including MOOCs and the Khan Academy.

A School in the Cloud and the Future of Learning

go.nmc.org/schoocl

(Michael V. Copeland, *Wired*, 27 February 2013.) TED speaker Sugata Mitra explores how deploying schools in the cloud promotes self-organized learning.

Time-to-Adoption: One Year or Less

Mobile Learning

People increasingly expect to be connected to the Internet and the rich tapestry of knowledge it contains wherever they go. Mobile devices, including smartphones and tablets, enable users to do just that via cellular networks and wireless power. At the end of 2012, the mobile market consisted of over 6.5 billion subscribers, with a majority living in developing countries. The growing number of users, coupled with the unprecedented evolution of these devices, has opened the door to myriad uses for education. Learning institutions all over the world are exploring ways to make their websites, educational materials, resources, and opportunities all available online and optimized for mobile devices. The most compelling facet of mobile learning right now is mobile apps. Smartphones and tablets have redefined what we mean by mobile computing, and in the past four to five years, apps have become a hotbed of development, resulting in a plethora of learning and productivity apps. These tools, ranging from annotation and mind-mapping apps to apps that allow users to explore outer space or get a more in-depth look at complex chemicals, enable users to learn and experience new concepts wherever they are, often across multiple devices.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- As a one-to-one solution, mobile learning presents an economic, flexible alternative to laptops and desktops due to the devices' lower cost, greater portability, and access to apps.
- Mobile apps with built-in social features enable learners to share their questions or findings with each other in real-time. For example, productivity apps such as Evernote and Edmodo make it possible to exchange notes, assignments, drawings, videos, and more.
- Students can leverage the cameras, microphones, and other tools inherent in mobiles to do field work or create rich media. This is especially convenient for work done outside of the classroom as students can record interviews, collect data for experiments, and more.

Mobile Learning in Practice

- Lee's Summit R-7 School District in Missouri created a web page with mobile learning resources, including apps, to promote the creative use of mobile devices for in-classroom and on-the-go learning: go.nmc.org/leesum.
- Mobile Education Lab is a creative organization that promotes the discovery and invention of digital content for exploring the potential of mobile technologies: go.nmc.org/erhcb.
- New Trier Township High School District in Illinois launched the Mobile Learning Initiative to evaluate the effectiveness of tablets for teaching and learning. Early reports cite improved student organization: go.nmc.org/ntthsd.

For Further Reading

Mobile Learning: 5 Advantages and 5 Disadvantages

go.nmc.org/mobile5

(Mashii Hajim, *Edudemic*, 28 December 2012.) Positive outcomes of mobile learning include increased engagement and wider access to educational resources. The author cites cost and battery life as potential negatives.

Mobile Learning Support for New Teachers

go.nmc.org/lisad

(Lisa Michelle Dabbs, *Edutopia*, 10 October 2012.) This article provides a framework for mobile learning for new teachers or schools considering a move to incorporating mobile learning, such as developing responsible use policies and planning mobile activities with students.

Time-to-Adoption: One Year or Less

Online Learning

Online learning is not new. What has made the topic new is the recent and unprecedented focus on providing learning via the Internet that has been stimulated by the tremendous interest in massive open online courses (MOOCs). What is new in this space is that online learning has “come of age;” the design of online learning is (more and more) specifically intended to encompass the latest research, the most promising developments, and new emerging business models in the online learning environment. At many institutions, online learning is an area newly ripe for experimentation — some would argue it is undergoing a sea change, with every dimension of the process open for reconceptualization. On campuses around the globe, virtually every aspect of how students connect with institutions and each other to learn online is being reworked, rethought, and redone — but it will be some time yet before ideas coalesce enough to be validated by research and implemented broadly.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- As new pedagogies emphasize personalized learning, there is a growing demand for learner-centered online opportunities. Online learning environments, when designed effectively, have the potential to scale globally.
- Online learning environments can make creative use of several educational technologies and emerging instructional approaches, including blended learning, video lectures, and badges.
- When placed online, a diverse set of learning resources is easily accessible to students and can support self-directed learning.

Online Learning in Practice

- The Buena Vista School District launched the Buena Vista Online Academy, an online alternative to a brick-and-mortar school for students: go.nmc.org/bvsdoa.
- Oregon Virtual Education is an online learning program that offers free enrollment. Classes can be taken to supplement or replace traditional classroom learning: go.nmc.org/orved.
- The University of Texas Online High School provides students with an opportunity to receive their high school diplomas through a flexible, distance education model: go.nmc.org/uths.

For Further Reading

How Online Learning is Saving and Improving Rural High Schools

go.nmc.org/rural

(Tom Vander Ark, *Getting Smart*, 26 January 2013.) Rural high schools face immense challenges, including federal and state education funding inequities, which causes many schools to close down every year. Online schools even the playing field.

States, Districts Require Online Ed for High School Graduation

go.nmc.org/require

(Kelsey Sheehy, *US News*, 24 October 2012.) A growing number of school districts, including those in Virginia and Idaho, have recently signed legislation making it mandatory for students to take at least one online course in order to graduate from high school.

The Teacher You've Never Met: Inside an Online High School Class

go.nmc.org/online

(Nick Pandolfo, *TIME*, 13 June 2012.) This article explores the life and work of an online K-12 teacher at Colorado's 21st Century Virtual Academy. The teacher reports frustrations in not being able to read students' body language to better understand their learning needs.

Time-to-Adoption: Two to Three Years

Electronic Publishing

Already firmly established in the consumer sector, electronic publishing is redefining the boundaries between print and digital, still image and video, passive and interactive. Modern digital workflows support almost any form in which content might appear, from traditional print to digital, web, video, and even interactive content. Building in the full spectrum of potential publishing avenues — print, web, video, mobiles and tablets, and interactives — from the beginning is not only a way to streamline production overall, but also to increase the reach of the materials produced by leveraging the content over a wide range of media. Modern media companies have been at the vanguard of this conversion. Magazine writers, for example, will produce a piece so that it will work in the magazine, on the web, and in video — and the finished product may appear in any or all of those outlets. If the first revolution in electronic publishing was making publishing platforms accessible to anyone, the next phase is the linking of these platforms together to produce new combinations and new types of content via turnkey syndication tools. With services like IFTTT (If This, Then That), the ability to syndicate content to multiple platforms is within reach of anyone.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Electronic publishing offers schools unprecedented opportunities of scale and richness by reorganizing the way images, audio and video, and layers of textual data are conceptualized.
- Modifying publishing workflows brings educational institutions in line with industry standard practices and allows them to reach entirely new audiences.
- New tools, such as iBooks Author, enable all kinds of people, including K-12 students, to create and disseminate their own e-books.

Electronic Publishing in Practice

- Apple recently extended iTunes U for the K-12 community, enabling teachers to publish their content for free download: go.nmc.org/jfjcd.
- Brain Hive has announced an on-demand eBook lending service for K-12 schools: go.nmc.org/skhlt.
- Public schools in Florida are gradually transitioning from textbooks to digital textbooks by 2015: go.nmc.org/ekqrx.

For Further Reading

Are Apps The Future of Book Publishing?

go.nmc.org/zoqfh

(Alex Knapp, *Forbes*, 30 March 2012.) Book apps are becoming a popular method of enhancing books and making them available for tablets or e-readers, with videos and more.

Dragging Learning into the Digital Age

go.nmc.org/dragging

(Khulekani Magubane, *Business Day*, 20 February 2013.) While some research indicates the student benefits of e-books, teachers across the globe may not yet have sufficient training.

Using E-Books in School

go.nmc.org/xuonk

(*The Journal*, accessed 26 September 2012.) This article describes experiences of some of the schools using digital textbooks and divulges the positive aspects as well as the drawbacks.

Time-to-Adoption: Two to Three Years

Learning Analytics

Learning analytics is an emergent field of research that aspires to use data analysis to inform decisions made on every tier of the educational system. Whereas analysts in business use consumer-related data to target potential customers and thus personalize advertising, learning analytics hopes to leverage student-related data to build better pedagogies, target at-risk student populations, and to assess whether programs designed to improve retention have been effective and should be sustained — important outcomes for administrators, policy makers, and legislators. For educators and researchers, learning analytics will provide crucial insights about student engagement both inside and outside of class. Students will also benefit from the deliverables of learning analytics through the development of mobile software and online platforms that use student-specific data to tailor support systems for their learning needs.

In many ways, learning analytics is “big data,” applied to education. The term owes its beginnings to data mining efforts in the commercial sector that used analysis of consumer activities to identify consumer trends. The rise of the Internet triggered a huge transformation in the field of market research and metrics as web-tracking tools (web analytics) enabled companies to keep track of customers and their purchases. With the avalanche of data derived from consumers, businesses began to seek out analysts who could decipher meaning from gigantic sets of data and develop models and predictions about consumer behavior to support marketing strategies. Similarly, educational institutions are embarking on their own explorations of the science of large data sets, with the aim of improving student retention and providing a higher quality, personalized experience for learners.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- If used effectively, learning analytics can help surface early signals that indicate a student is struggling, allowing teachers and schools to address issues quickly.
- When correctly applied and interpreted, learning analytics will enable teachers to more precisely identify students’ learning needs and tailor instruction appropriately.

Learning Analytics in Practice

- The mobile app GoSoapBox allows students to anonymously ask questions to their teachers and participate in discussions via smartphone, tablet, or laptop: go.nmc.org/xofii.
- Rancocas Valley Regional High School in New Jersey is collecting real-time feedback of standards-based declarative and procedural knowledge: go.nmc.org/bclnm.
- Teachers at Crescent Girl’s School in Singapore use WriteToLearn, which analyzes written text based on linear algebraic models, to evaluate writing assignments: go.nmc.org/musok.

For Further Reading

Learning and Knowledge Analytics (PDF)

go.nmc.org/laknow

(George Siemens and Dragan Gasevic, *Journal of Educational Technology & Society*, Vol. 15, No. 3, October 2012.) Seminal learning analytics experts George Siemens and Dragan Gasevic discuss the maturation of learning analytics and its impact on education.

The Upside and Dark Side of Collecting Student Data

go.nmc.org/upside

(Katrina Schwartz, *MindShift*, 11 February 2013.) The author describes how learning analytics can provide data that helps educators better tailor learning experiences to individual students, but also cautions against companies who are using data collection to track children's activities.

Time-to-Adoption: Two to Three Years

Open Content

The movement toward open content reflects a growing shift in the way scholars in many parts of the world are conceptualizing education to a view that is more about the process of learning than the information conveyed. Information is everywhere; the challenge is to make effective use of it. Open content uses Creative Commons and other forms of alternative licensing to encourage not only the sharing of information, but the sharing of pedagogies and experiences as well. Part of the appeal of open content is that it is a response to both the rising costs of traditionally published resources and the lack of educational resources in some regions. As this open, customizable content — and insights about how to teach and learn with it — is increasingly made available for free over the Internet, people are learning not only the material, but also the skills related to finding, evaluating, interpreting, and repurposing the resources. Recent data from *Edcetera* indicate that open educational resources make up three quarters of the content in most MOOCs; paid content, such as required textbooks, is less than 10%. These data reflect a notable transformation in the culture surrounding open content that will continue to impact how we think about content production, sharing, and learning.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Open, sharable materials reduce teacher workloads; open educational resources do not need to be created from scratch.
- Most of the world's top institutions are providers of open content and have created a wealth of materials now available on demand to anyone.
- The use of open content promotes a set of skills that are critical in maintaining currency in any area of study — the ability to find, evaluate, and put new information to use.

Open Content in Practice

- CK-12 is a non-profit organization, striving to provide a robust selection of textbooks at significantly lower costs. With CK-12 Flexbooks, students and teachers choose from a wide range of open content textbooks, specific to STEM education: go.nmc.org/ck12.
- The OER Commons provides free and open learning resources that are curated by subject experts: go.nmc.org/oercommons.
- The Open High School of Utah is an online charter high school that leverages next-generation learning technology and strategic one-on-one tutoring: go.nmc.org/openhs.

For Further Reading

19 Open Resources for High School by Category

go.nmc.org/19oer

(*TeachThought*, 17 October 2012.) *TeachThought* lists effective open educational resources for specific subjects and grade levels, including Educurious and the Khan Academy.

Open Resources: Transforming the Way Knowledge Is Spread

go.nmc.org/openre

(D. D. Guttenplan, *The New York Times*, 18 March 2012.) This article examines the state of open content in education. The author sees open content as vital to extending literacy and opportunity while cutting costs for schools, families, and students worldwide.

Running a School on Open Educational Resources

go.nmc.org/running

(Bridget McCrea, *The Journal*, 9 May 2012.) An interview with the Open High School of Utah Director provides insight on integrating open content into K-12 curriculum.

Time-to-Adoption: Two to Three Years

Personalized Learning

Personalized learning has been evolving for some time, and includes a wide variety of approaches to support self-directed and group-based learning that can be designed around each user's goals, including personalized learning environments and networks, adaptive learning tools, and more. Using a growing set of free and simple resources, such as a collection of apps on a tablet, it is already quite easy to support one's ongoing social and professional learning and other activities with a collection of resources and tools that people always have on hand.

There are two paths of development for personalized learning: the first is organized by and for the learner, which includes these resources (e.g., apps, social media, etc.); and institutional goals and interests are driving the other in the form of adaptive learning. In this view, which envisions tools and data streams that are still some time away from being seen in schools, adaptive learning is enabled by intervention-focused machine intelligence that interprets data about how a student is learning and responds by changing the learning environment based on their needs. A lack of concrete examples indicates that adaptive learning will not find mainstream applications in traditional classrooms over the next two to three years. It is likely that adaptive learning will first appear in large online environments from which big data can be extracted and patterns identified, based on the thousands of students in attendance.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Adaptive learning tools are envisioned as providing students and educators with real-time information about how lessons are progressing, with adjustments made in real time to better cater to the immediate learning needs.
- Inherently sensitive to learning styles, personalized learning caters, for instance, to visual learners by providing different forms of materials than for textual or auditory learners.
- Personalized learning is seen as a key and necessary component of the next generation of schools and learning.

Personalized Learning in Practice

- The Aspire Charter School in Tennessee is offering a blended environment for teaching computer coding in which students are using adaptive learning software: go.nmc.org/aspire.
- In the iLab initiative, Wiscasset High School students use tools like Evernote and Vimeo to build personalized learning environments for independent study projects: go.nmc.org/ilabnet.
- K-5 students at the Florida Virtual School are using Dreambox Learning's math program to receive individualized instruction that adapts to their learning needs: go.nmc.org/k5adapt.

For Further Reading

Is Adaptive Learning the Future of Education?

go.nmc.org/isadap

(Nicholas Montgomery, *Betakit*, 19 May 2012.) Many companies are using large sets of data points to create customized learning experiences and up-to-date student profiles.

Why (And How) You Should Create A Personal Learning Network

go.nmc.org/whyand

(Eric Patnoudes, *Edudemic*, 1 October 2012.) The author describes why K-12 educators should create their own personalized learning networks and offers ten ways to build their community and resources.

Time-to-Adoption: Four to Five Years

3D Printing

Known in industrial circles as rapid prototyping, 3D printing refers to technologies that construct physical objects from three-dimensional (3D) digital content such as 3D modeling software, computer-aided design (CAD) tools, computer aided tomography (CAT), and X-ray crystallography. A 3D printer builds a tangible model or prototype from the electronic file, one layer at a time, through an extrusion-like process using plastics and other flexible materials, or an inkjet-like process to spray a bonding agent onto a very thin layer of fixable powder. The deposits created by the machine can be applied very accurately to build an object from the bottom up, layer by layer, with resolutions that, even in the least expensive machines, are more than sufficient to express a large amount of detail. The process even accommodates moving parts within the object. Using different materials and bonding agents, color can be applied, and parts can be rendered in plastic, resin, or metal. This technology is commonly used in manufacturing to build prototypes of almost any object (scaled to fit the printer, of course) that can be conveyed in three dimensions.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- 3D printing allows for more authentic exploration of objects that may not be readily available to schools, including animal anatomies and toxic materials.
- The exploration of the 3D printing process from design to production, as well as demonstrations and participatory access, can open up new possibilities for learning activities.
- Typically, students learning anthropology and geology are not allowed to handle fragile objects like fossils and artifacts; 3D printing shows promise as a rapid prototyping and production tool, providing users with the ability to touch, hold, and even take home an accurate model.

3D Printing in Practice

- At the Limestone County Career Technical Center in Alabama, local high school students are using 3D printers to design and build models they can hold and explore: go.nmc.org/lcs3d.
- The STEM Academy recently announced a partnership with 3D printing company Stratasys to integrate 3D printers into programming classes: go.nmc.org/stem3d.
- Through the Nellis STARBASE program, Perkins Elementary School students used 3D printers to engineer a device that could hold eggs securely in a pulley system: go.nmc.org/perkins.

For Further Reading

7 Educational Uses for 3D Printing

go.nmc.org/7ed3d

(Nancy Parker, *Getting Smart*, 14 November 2012.) There is a vast array of uses for 3D printers in education, including the development of body part models for biology.

Making it Real with 3D printing

go.nmc.org/making

(Drew Nelson, *InfoWorld*, 11 December 2012.) This article highlights the emergence of open source 3D printers, which got their start in 2007, and have now developed into less expensive, more efficient models as users share, copy, and improve upon the model designs.

What Can be Made with 3-D Printers?

go.nmc.org/whacan

(*The Washington Post*, 4 January, 2013.) A photo slideshow reveals a series of objects that were created from 3D printers, including an iPhone case, a shoe, and Les Paul guitar model.

Time-to-Adoption: Four to Five Years

Augmented Reality

Augmented reality (AR), a capability that has been around for decades, has shifted from what was once seen as a gimmick to a tool with tremendous potential. The layering of information over 3D space produces a new experience of the world, sometimes referred to as “blended reality,” and is fueling the broader migration of computing from the desktop to the mobile device, bringing with it new expectations regarding access to information and new opportunities for learning. While the most prevalent uses of augmented reality so far have been in the consumer sector (for marketing, social engagement, amusement, or location-based information), new uses seem to emerge almost daily, as tools for creating new applications become even easier to use. A key characteristic of augmented reality is its ability to respond to user input, which confers significant potential for learning and assessment; with it, learners can construct new understanding based on interactions with virtual objects that bring underlying data to life. Dynamic processes, extensive datasets, and objects too large or too small to be manipulated can be brought into a learner’s personal space at a scale and in a form easy to understand and work with.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Augmented reality has strong potential to provide powerful contextual, *in situ* learning experiences and serendipitous exploration as well as the discovery of the connected nature of information in the real world.
- Games that are based in the real world and augmented with networked data can give educators powerful new ways to show relationships and connections.
- Students visiting historic sites can access AR applications that overlay maps and information about how the location looked at different points in history.

Augmented Reality in Practice

- Letters Alive is a supplemental reading program utilizing augmented reality to teach children ages 4-8 how to read: go.nmc.org/letter.
- Shaw Wood Primary School in the UK uses Aurasma, a free app, to publish and share augmented reality content: go.nmc.org/auras.
- A wiki was launched to explore the applications of augmented reality for special education, specifically for deaf and blind students: go.nmc.org/augme.

For Further Reading

5 Top Augmented Reality Apps for Education

go.nmc.org/5top

(Gabriela Jugaru, Hongkiat.com, accessed 19 March 2013.) This post profiles five apps, including Google Sky Map, ZooBurst, and Fetch, that make astronomy, math, and storytelling come to life through the layering of digital information over real-world surroundings.

How to Augment Your Reality with AR

go.nmc.org/funig

(Margriet Schavemaker, *edgital*, 12 October 2012.) The author of this post discusses how to make a custom AR learning experience, particularly in a large-scale environment.

The World Is Not Enough: Google and the Future of Augmented Reality

go.nmc.org/yvgbu

(Alexis C. Madrigal, *The Atlantic*, 25 October 2012.) Between Google Glass and the Field Trip app, Google is incorporating augmented reality into new tools.

Time-to-Adoption: Four to Five Years

Virtual and Remote Laboratories

Virtual and remote laboratories reflect a movement among education institutions to make the equipment and elements of a physical science laboratory more easily available to learners from any location, via the web. Virtual laboratories are web applications that emulate the operation of real laboratories and enable students to practice in a “safe” environment before using real, physical components. Students can typically access virtual labs 24/7, from wherever they are, and run the same experiments over and over again. Some emerging virtual lab platforms also incorporate reporting templates that populate with the results of the experiments so that students and teachers can easily review the outcomes.

Remote laboratories, on the other hand, provide a virtual interface to a real, physical laboratory. Institutions that do not have access to high-caliber lab equipment can run experiments and perform lab work online, accessing the tools from a central location. Users are able to manipulate the equipment and watch the activities unfold via a webcam on a computer or mobile device. This provides students with a realistic view of system behavior and allows them access to professional laboratory tools from anywhere, whenever they need. Additionally, remote labs alleviate some financial burden for institutions as they can forgo purchasing specific equipment and use the remote tools that are at their disposal.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Because virtual laboratories do not involve real equipment or chemicals, students can feel more comfortable making mistakes and running experiments as often as they like.
- Educators can play back videos of the experiments students have run online, pinpoint areas of improvement, and acknowledge students who have excelled.
- Virtual and remote laboratories increase access to science tools, allowing learners from all over the world to use them via wireless or cellular networks; laboratory work is no longer limited to spaces on physical campuses.

Virtual and Remote Laboratories in Practice

- Kentucky Educational Television launched the Virtual Physics Lab, designed for the introductory exploration of concept development for physics. The virtual apparatus simulates real life scientific laboratory equipment: go.nmc.org/ketvl.
- Northwestern University’s remote online lab is increasing the use of technology in math and science by facilitating access for high school students: go.nmc.org/projacc.
- The NYU-Poly Virtual Lab is a free online lab for high school students where they can participate in and design forensics projects: go.nmc.org/vital.

For Further Reading

Flipping Lab Science with Remote Labs

go.nmc.org/flipsci

(Jim Vanides, *Guide2DigitalLearning*, accessed 19 March 2013.) The author explores the role of remote science labs in the flipped classroom model.

Virtual Lab Environment

go.nmc.org/hatsize

(*Hatsize Blog*, 9 February 2013.) This post provides a concise overview of virtual laboratories and explores the positive outcomes as well as some drawbacks.

Time-to-Adoption: Four to Five Years

Wearable Technology

Wearable technology refers to devices that can be worn by users, taking the form of an accessory such as jewelry, sunglasses, a backpack, or even actual items of clothing such as shoes or a jacket. The benefit of wearable technology is that it can conveniently integrate tools, devices, power needs, and connectivity within a user's everyday life and movements. Google's "Project Glass" is one of the most talked about current examples — the device resembles a pair of glasses, but with a single lens. A user can see information about their surroundings displayed in front of them, such as the names of friends who are in close proximity, or nearby places to access data that would be relevant to a research project. Wearable technology is still very new, but one can easily imagine accessories such as gloves that enhance the user's ability to feel or control something they are not directly touching. Wearable technology already in the market includes clothing that charges batteries via decorative solar cells, that allows interactions with a user's devices via sewn-in controls or touch pads, or that collects data on a person's exercise regimen from sensors embedded in the heels of their shoes.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Smart jewelry or other accessories could alert wearers to hazardous conditions, such as exposure to carbon monoxide.
- Wearable devices and cameras can instantly capture hundreds of photographs or data about a user's surroundings that can be later accessed via email or other online application.
- Wearable technology can automatically communicate information via text, email, and social networks on behalf of the user, based on voice commands, gestures, or other indicators.

Wearable Technology in Practice

- A new robotic suit created by Koba Lab from Tokyo University of Science provides support to the wearer's back, shoulders, and elbows, enabling them to carry more weight and perform more difficult physical tasks: go.nmc.org/lift.
- Researchers at Melbourne's Bionic Institute are creating implantable bionic devices, including electrodes that can be inserted into the brain to detect abnormal activity and deliver treatment: go.nmc.org/brain.
- The Wearable Computer Lab at the University of South Australia develops augmented reality-enabled wearable devices and specializes in human-computer interaction techniques: go.nmc.org/unisa.

For Further Reading

Here's Proof That Wearable Tech Is The Next Big Thing

go.nmc.org/nex

(Megan Rose Dickey, *Business Insider*, 5 Jan 2013.) In the consumer market, wearable technology has taken off in the form of electronic drum machine t-shirts, waterproof bikinis that absorb sunlight to charge electronics, and boots that use the heat a wearer creates from walking to charge a smartphone.

Wearable Tech Pioneers Aim to Track and Augment our Lives

go.nmc.org/wea

(Jane Wakefield, *BBC News*, 17 October 2012.) This article highlights the potential of wearable technology, including cameras that automatically snap photos, watches that sync with email accounts to display emails and reminders, and more.

Key Trends

The abundance of resources and relationships made easily accessible via the Internet is challenging us to revisit our roles as educators. Institutions must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live and work is again at the forefront. K-12 institutions have always been seen as critical paths to educational credentialing, but challenges from competing sources are redefining what these paths can look like.

As the cost of technology drops and school districts revise and open up their access policies, it is becoming more common for students to bring their own mobile devices. A growing number of schools are launching “Bring Your Own Device” (BYOD) programs so that students can use the devices they already own in class as well as in the informal and out-of-school environments they are ubiquitous in now. This is happening partly because of how BYOD impacts budgets; schools can spend less money on technology overall if students use their own, while funneling the funds they do spend to help students who cannot afford their own devices. The interest in BYOD programs can also be attributed to an attitude shift as schools are beginning to better understand the capabilities of smartphones and other devices that still remain banned on most campuses.

Customized learning is increasingly a goal for schools. Given a device of their own, nearly anyone will immediately set about personalizing and customizing the settings and apps to reflect their own preferences. Extending this same approach to learning is becoming more possible as technology evolves to meet personal learning needs. The goal is for students to have more control over how they learn in school, just as they do at home, and for teachers to set expectations that their students will be actively engaged in designing and supporting their own learning strategies.

Education paradigms are shifting to include online learning, hybrid learning, and collaborative models. Students already spend much of their free time on the Internet, learning and exchanging new information — often via their social networks. Institutions that embrace face-to-face/online hybrid learning models have the potential to leverage the online skills learners have already developed independent of academia. Online learning environments can offer different affordances than physical campuses, including opportunities for increased collaboration while equipping students with stronger digital skills. Hybrid models, when designed and implemented successfully, enable students to travel to campus for some activities, while using the network for others, taking advantage of the best of both environments.

The focus of assessments is shifting from "what you know" to "what you can do." Rather than demonstrating knowledge via multiple choice tests and quizzes, there is an emphasis on students actually applying what they have learned. Examples include students producing e-books, generating mind maps through mobile apps, or creating interactive artwork, and designing solutions to local or global problems. While the notion of an e-portfolio is still controversial, it is becoming more important for students to have a body of work to show for the knowledge and skills they have gained.

Openness — concepts like open content, open data, and open resources, along with notions of transparency and easy access to data and information — is becoming a value. As authoritative sources lose their importance, there is need for more curation and other forms of validation to generate meaning in information and media. “Open” continues its diffusion as a buzzword in education, and it is essential to understand the definition. Often mistakenly equated only with “free,”

open education advocates are working towards a common vision that defines “open” as free, copiable, remixable, and without any barriers to access or interaction.

People expect to be able to work, learn, and study whenever and wherever they want. This trend is certainly true for most adults, and many well-paying jobs literally can be done from anywhere that has a mobile Internet connection. It is also true for many of today’s school-age children, who live their lives in a state of constant connection to their peers, social groups, and family. While some decry the constant flow of information as a distraction or worse (with some justification), others see the opportunity to “flip” expectations about what is homework and what is schoolwork by taking advantage of those connections as learning opportunities. The implications for formal learning are profound, as flipping uses the resources on the Internet to free up valuable teacher classroom time, and fundamentally changes the teacher-student relationship. When students know how to use their network connections for more than texting, learning becomes much more serendipitous, opening the door to “just-in-time” learning, and “discovered” learning.

Schools are beginning to move away from textbooks to web resources and open source books. There are two concepts driving this trend: 1) the evolution of e-books and 2) the increasing acceptance and dissemination of open content. As e-book technology advances, digital textbooks contain more dynamic content, including audio, videos, and other interactive features. Traditional textbooks are cumbersome and can take years to update and reprint when there is new information and discoveries to be added. E-books, especially when open source, can be more easily revised and disseminated. In the second scenario, there is a group of thought leaders who believe textbooks — whether — physical or digital — are becoming obsolete, due in part to the rise of open educational resources. Examples include free video lectures from the Khan Academy and crowd-sourced intelligence like Wikipedia. Many educators are turning to interactive whiteboards, including the eBeam, to share the same type of information that a student would read in textbooks. The goal in this is to make teaching and learning more active experiences.

Social media is changing the way people interact, present ideas and information, and communicate. More than one billion people use Facebook regularly; other social media platforms extend those numbers to nearly one third of all people on the planet. Educators, students, alumni, and even the general public routinely use social media to share news about scientific and other developments. Likewise, scientists and researchers use social media to keep their communities informed of new developments. The fact that all of these various groups are using social media speaks to its effectiveness in engaging people. The impact of these changes in scholarly communication and on the credibility of information remains to be seen, but it is clear that social media has found significant traction in almost every education sector.

There is a new emphasis in the classroom on more challenge based, active learning. Challenge Based Learning and similar methods foster more active learning experiences, both inside and outside the classroom. As technologies such as tablets and smartphones now have proven applications in schools, educators are leveraging these tools, which students already use, to connect the curriculum with real life issues. The active learning approaches are decidedly more student-centered, allowing them to take control of how they engage with a subject and to brainstorm and implement solutions to pressing local and global problems. The hope is that if learners can connect the course material with their own lives and their surrounding communities, then they will become more excited to learn and immerse themselves in the subject matter. Studies of Challenge Based Learning in practice, including two authored by the NMC, depict an increase in the uptake of 21st Century Skills among learners, including leadership and creativity.

Significant Challenges

The demand for personalized learning is not adequately supported by current technology or practices. The increasing demand for education that is customized to each student's unique needs is driving the development of new technologies that provide more learner choice and control and allow for differentiated instruction, but there remains a gap between the vision and the tools needed to achieve it. It has become clear that one-size-fits-all teaching methods are neither effective nor acceptable for today's diverse students. Technology can and should support individual choices about access to materials and expertise, amount and type of educational content, and methods of teaching.

Divides persist. Emerging technologies alone are not equalizers for rural and urban populations. Children who live in rural areas, for example, cannot always connect to cellular networks and are more likely to have no cable or high-speed Internet connectivity at home. Furthermore, educational content does not necessarily render properly on all mobile devices. As a result, these students may need more resources and more attention from teachers to be able to reach the same standards as students in other locales. On the other hand, many technologies are providing opportunities for personalization. Playlists on Gooru, adaptive math programs, and self-paced online courses all contribute to an environment in which learners from all over the globe can be challenged at the appropriate level; it is just a matter of educators guiding them through these types of resources so they can better direct their learning and understand what tools they need to stay on track.

Faculty training still does not acknowledge the fact that digital media literacy continues its rise in importance as a key skill in every discipline and profession. Despite the widespread agreement on the importance of digital media literacy, training in the supporting skills and techniques is rare in teacher education. As teachers begin to realize that they are limiting their students by not helping them to develop and use digital media literacy skills across the curriculum, the lack of formal training is being offset through professional development or informal learning, but we are far from seeing digital media literacy as a norm. This challenge is exacerbated by the fact that digital literacy is less about tools and more about thinking, and thus skills and standards based on tools and platforms have proven to be somewhat ephemeral.

Innovating pedagogy is a complex process that requires research into impacts, responsive state of mind to technology changes, and understanding what pedagogical strategies can make innovation in pedagogy possible. Before in-service teachers adjust their style and university programs train pre-service teachers on new pedagogies, a significant amount of time should be devoted to understanding the implications of these emerging approaches.

K-12 must address the increased blending of formal and informal learning. Traditional lectures and subsequent testing are still dominant learning vehicles in schools. In order for students to get a well-rounded education with real world experience, they must also engage in more informal in-class activities as well as learning to learn outside the classroom. Most schools are not encouraging students to do this, nor to experiment and take risks with their learning. A new model, called the "flipped classroom," however, is opening the door to new approaches. The flipped classroom uses the abundance of educational materials on the Internet to allow students to learn new concepts and material outside of school, thus preserving class time for discussions, collaborations with classmates, problem solving, and experimentation. The approach is not a panacea, and designing an effective blended learning model is key, but the growing success of the many non-traditional alternatives to schools that are using more informal approaches indicates that this trend is here to stay for some time.

Many activities related to learning and education take place outside the walls of the classroom and thus are not part of traditional learning metrics. Students can take advantage of learning material online, through games and programs they may have on systems at home, and through their extensive — and constantly available — social networks. The experiences that happen in and around these venues are difficult to tie back to the classroom, as they tend to happen serendipitously and in response to an immediate need for knowledge, rather than being related to topics currently being studied in school.

New models of education are bringing unprecedented competition to the traditional models of education. Across the board, institutions are looking for ways to provide a high quality of service and more learning opportunities. MOOCs are at the forefront of these discussions, enabling students to supplement their education and experiences at brick-and-mortar schools with increasingly rich, and often free, online offerings. As these new platforms emerge, however, there is a need to frankly evaluate the models and determine how to best support collaboration, interaction, and assessment at scale. Simply capitalizing on new technology is not enough; the new models must use these tools and services to engage students on a deeper level.

Ongoing professional development needs to be valued and integrated into the culture of the schools. There is immense pressure placed on teachers to incorporate emerging technologies and new media in their classrooms and curriculum. Some schools, however, mandate the use of a specific technology but either fail to provide professional development or have a one-day workshop approach that leaves teachers without the skills to effectively integrate the technology long-term. The results are that the new tools are underutilized, not used at all, or used in a way that mimics an old process rather than innovating new processes that may be more engaging for students.

Too often it is education's own processes and practices that limit broader uptake of new technologies. Much resistance to change is simply comfort with the status quo, but in other cases, such as in promotion and tenure reviews, experimentation or innovative applications of technologies are often seen as outside the role of researcher or scientist, and thus discouraged. Changing these processes will require major shifts in attitudes as much as they will in policy.

We are not using digital media for formative assessment the way we could and should. Assessment is an important driver for educational practice and change, and over the last years we have seen a welcome rise in the use of formative assessment in educational practice. However, there is still an assessment gap in how changes in curricula and new skill demands are implemented in education; schools do not always make necessary adjustments in assessment practices as a consequence of these changes. Another assessment gap is related to the lack of innovative uses of digital media in formative assessment. Many tools are still tied to outdated LMS and do not have the ability to assess critical data sets, such as 21st Century Skills acquisition.

